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Battling the tropics to settle a nation: Negotiating multiple energies, frontiers and feedback loops in Australia

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ABSTRACT

Multiple forms and spaces of energy are enrolled in nation-building projects. In this cross-disciplinary paper, we outline how struggles to govern the relations between climate and the human body have shaped nation-building efforts and electricity infrastructure in the settler-colonial society of Australia. Focused on Australia's tropical zone, notably the hot, recalcitrant, militarized region of the Northern Territory, we explore how questions of climate have slowed, undone and accelerated efforts to securely settle its capital city, Darwin. In doing so, we highlight the multiple links between electricity infrastructure and air-conditioning that have made it possible to hold 'climate' and 'body' together, co-producing indoor microclimates and habitable territory while contributing to the warming climate that is now raising questions about the limits of this electricity-enabled habitability. By examining the intersecting spatialities of electricity, we help advance more 'thoroughly geographical' (Bridge, 2018) accounts of the relation between energy infrastructures and nation-building, highlighting the multiple forms, frontiers and feedback loops through which energy – broadly defined, as foundational category – acts as hindrance, enabler and side-effect of nation-building projects. We show how this perspective reveals troubling paradoxes and tensions, including accelerating feedbacks between energy use and climate change extending far beyond Australia's borders.

1. Introduction

In 2016, Exercise Kowari brought American, Chinese and Australian troops together to practice survival skills in the Northern Territory (NT), Australia. According to their survival specialist, 'The primary objective', was for them to 'learn how to manage heat'.[1] Trying to avoid heat is the way many of us manage it, notably by staying inside cooled microenvironments. In the tropics of northern Australia (Fig. 1), where the NT is largely positioned, keeping cool is core to normal life. Although military training makes a merit of the region's heat, it is more commonly framed as a liability. Or at least it was, until the American idea of air-conditioning and related technology and electricity infrastructure was introduced, making the settlement of NT, especially its capital city Darwin, feel feasible. While the struggle to place the NT's capital city of Darwin on the map may now seem over, increasing temperatures and other climate change effects now threaten to undermine the sufficiency and reliability of electrical flows in the region, with far-reaching implications for Australia's anxious nation-building project.

In this paper, we discuss electricity in Darwin to explore how climate, notably tropical heat, has acted as a brake, threat and driver in relation to energy infrastructure and nation-building in and beyond the subnational region. In presenting this case study we highlight the multiple powers, energies, frontiers and feedback loops involved in Australia's nation-building effort and the way in which energy – broadly defined – acts as hindrance, enabler and side-effect as well as output in ongoing nation-building struggles. Drawing on energy geography, postcolonial studies, climate change research and urban studies, we bring together historical, cultural, political, economic, sociological, medical and military aspects of nation-building to highlight how fundamental the question of energy is at multiple scales, from the bodies of electricity maintenance workers, to the reach of transnational fuel transportation, and from colonial era syntheses of nations' climatic and corporeal energy, to contemporary maps of future climates. In these ways, we work across scales, spatialities and temporalities to help develop 'more thoroughly geographical accounts of energy systems' and insights into the ways in which they have and may change [1] (p. 8).

We begin by outlining how a consideration of the relationship between climate (heat specifically) and energy (electricity specifically) deepens our understanding of the multiple spatialities of energy

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[1] http://www.abc.net.au/news/2016-09-08/exercise-kowari-troops-return-after-learning-new-skills/7828044.

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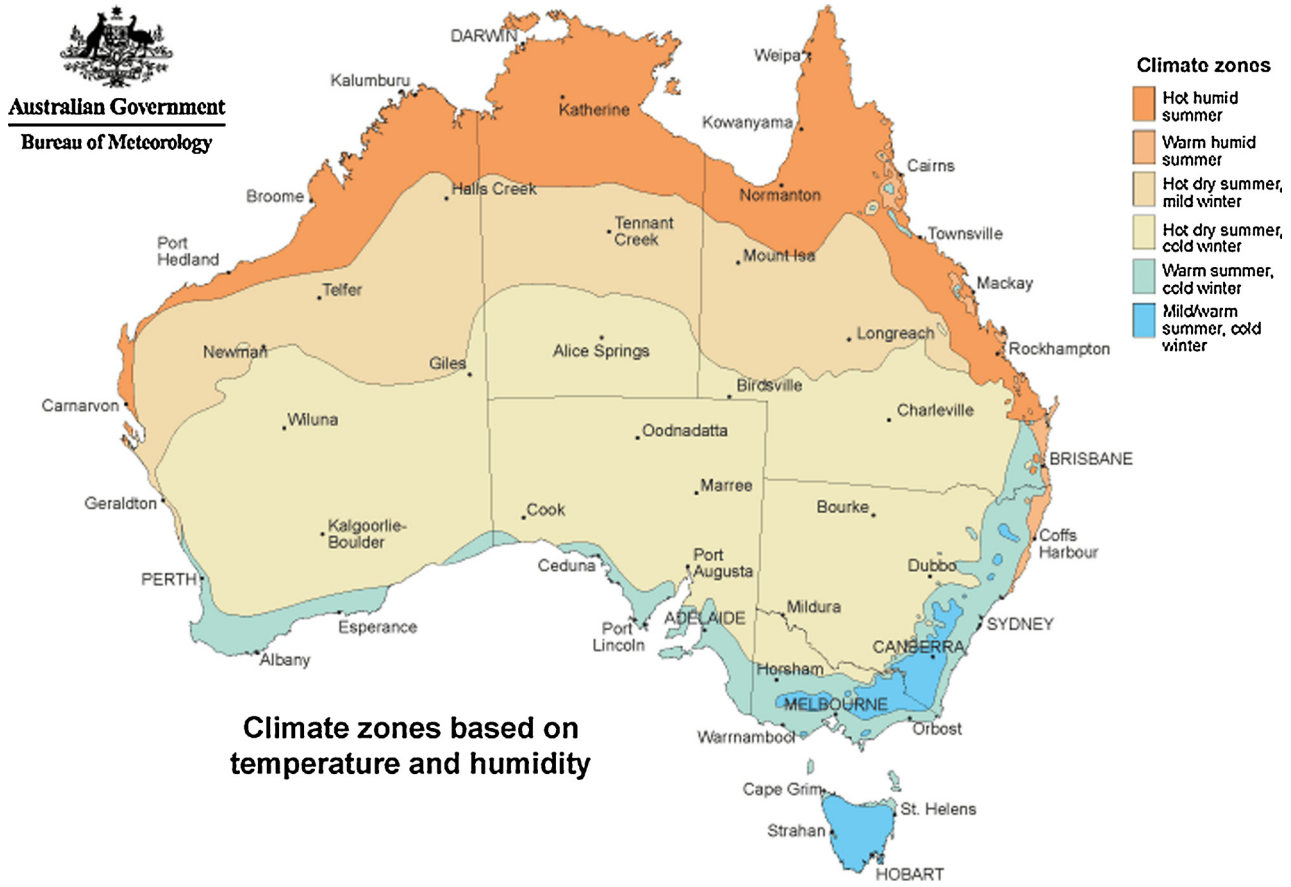


Fig. 1. Current spatial distribution of Australia's climate zones.

systems, including not just the nation or the globe but the subnational region, the city, the building and the neglected topic of the body, notably the environment-physiology relation that helps analytically connect discussions about energy production and consumption. We then draw on a range of secondary sources to examine these intersecting spatialities through the case of the NT, where British colonial concerns about the specific relation between the tropical environment and human bodies slowed the spread of electricity infrastructure, threatens its continuity, and is driving its development as military, economic and amenity needs within and beyond the NT converge. To conclude, we summarise our three main contributions.

2. Foundational energy: nation, infrastructure, bodies

Social science scholarship on energy tends to focus on the concentrated, inanimate sort. But Matthew Huber has recently called for political ecological scholarship that approaches energy as 'a foundational category of analysis' (p. 488). By talking about foundations, Huber is not only pointing to the *significance* of energy to contemporary industrial society. He is also pointing to the way an energy orientation can reveal the pervasiveness of energy, its multiple forms and arenas, and the commonalities and direct links between them. Together they produce space at different scales and are entwined and mediated 'by history, culture, and politics' (p. 488). In this paper we take up Huber's challenge and extend his focus beyond geological and ecological energetic relations to questions of the atmospheric and biological. In doing so, we emphasise the role of not just history, culture, and politics but infrastructure specifically. In this section, we provide a brief, historically based discussion of the question of (1) nation, (2) infrastructure and (3) bodies to explore how they are bound in multiple ways by the question of energy.

2.1. Constructing nations amidst the climate-body relation

Nation-building has long been fuelled by the use and accumulation of energy as a resource, whether that energy be animate biological forms of energy such as animal or slave labour, or inanimate geological forms of energy such as oil (see [2]). All over the world, people, animals, machinery and other resources have been assembled into particular configurations to produce national economies and territory. But as studies of European empires and settler colonialism makes clear (e.g. [3]), many of these nation-making processes were and are positioned in wider imperial circuits in which a further question of energy was and remains a key consideration: climate. As they traveled beyond their home temperate territories, imperial explorers encountered new tropical climates seemingly saturated with excessive thermal energy. These embodied experiences stimulated debate about the effects of climatic conditions on human bodies, civilization and settlement. Verdant tropical landscapes seemingly promised enormous economic and territorial potential *if* the negative effects of the strange climate on would-be settler populations could be managed. The colonial notion of 'tropicality' juxtaposed the 'unhealthy, unbearably hot and uncivilised' tropics [4] (p. 1198) to 'the perceived normality of the northern temperate zone' ([5] p. 2). Some doubted white Europeans could exist in the excessive temperatures and humidity of the tropical climates without degenerating, casting into doubt the whole colonial settlement project [3,6].[2] With these unsettling question marks over the once presumed inherent superiority of Europeans over racialised Others, Europeans' capacity to manage environmental thermal energy emerged as a key focus for debate, anxiety and effort.

[2] The links between climate and colonialism are entwined with questions of race being debated at the time. For more on this, see McGregor [3].

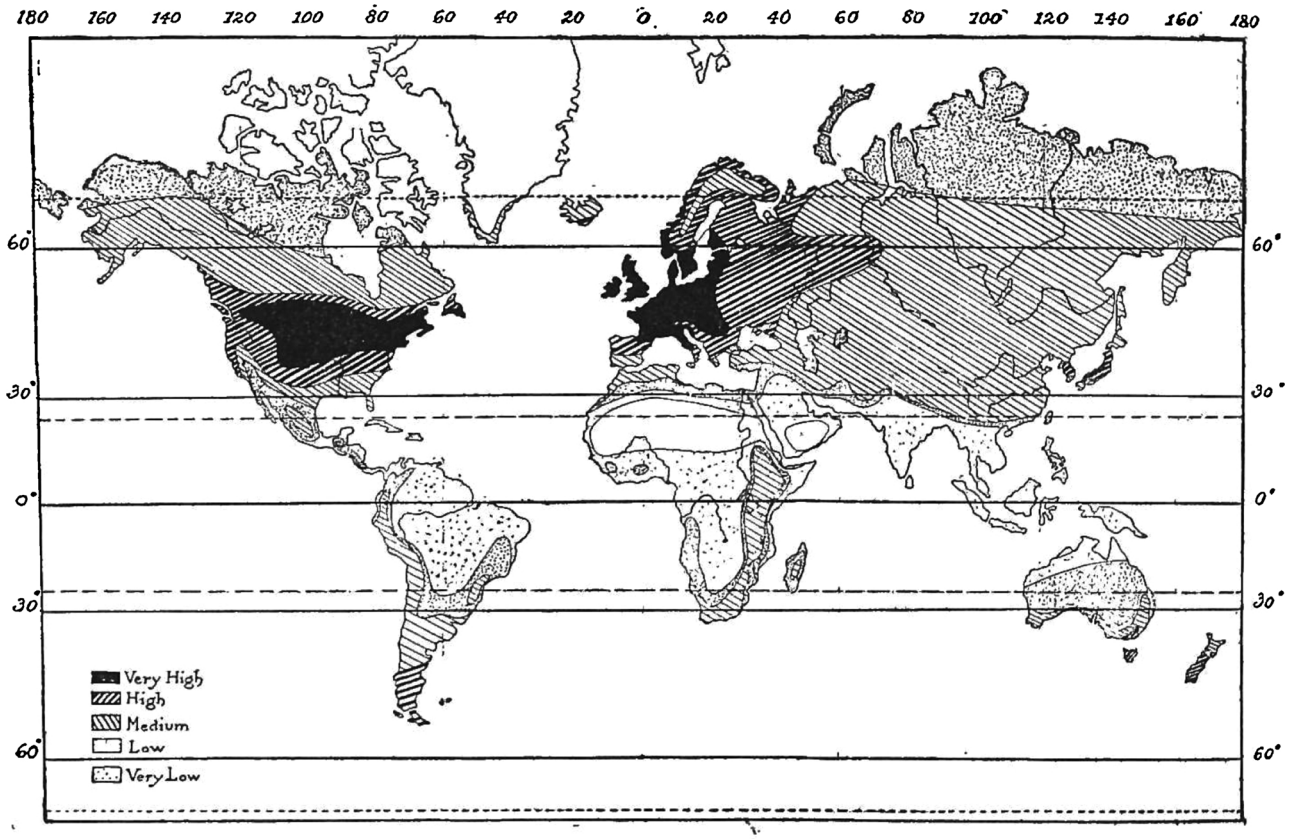


Fig. 2. Global map of "human health and energy" by American geographer Ellsworth Huntington.
Source: Huntington (1922, page 142 [74]).

Deliberately managing atmospheric and climatic conditions became fundamental to the broader colonial project of managing people and things across an expanding, heterogeneous territorial space. Indeed, Michel Foucault suggests that it helped give birth to a biopolitical form of governance, one concerned less with the claiming of territory than with the question of distributing and producing certain human populations. Such populations were to be created not by intervening with them directly, as in the case of earlier disciplinary governance, but by turning to 'the milieu' (environment) and seeking to manipulate circulations: 'allowing circulations to take place… controlling them, sifting the good and the bad, ensuring that things are always in movement' ([7] p. 22, 65). Foucault presents French demographer Jean Baptiste Moheau as 'the first great theorist of what we could call biopolitics' for his assertions that 'it is up to the government' to not only take environmental conditions seriously but 'to change the air temperature and to improve the climate… [to create] a new climate' in order 'to govern the physical and moral existence of their subjects' and try to 'give whatever hue we wish to morality and the national spirit' (Moheau 1778, in [7] p. 22–23). Whether in the name of Empire or subsequent independent nations, the perceived relationship between climatic conditions and humans' capacities meant that the ambition of the settler colonial project came to hinge to a significant degree on not just the human capacity to harness energy as a resource, but on taming it as an environmental condition.

The environment-physiology relationship faded as a major political preoccupation as an economic reliance on the animate energy of human bodies was largely replaced by one on the inanimate energy of machines. But during the colonial era, outdoor manual labour and thus the influence of the environment on human physiology remained central. In the tropics, the colonial governors' primary biopolitical challenge was working out how to use their own and others' bodily energy in order to claim the economic potential of tropical regions without the exertion causing dangerous bodily overheating given the heat of the environment. This perceived intersection of human, environmental and economic energies was strengthened in the twentieth century by Ellsworth Huntington's production of global maps of "human health and energy" (e.g. Fig. 2). Indicative of a strong sense of the commonalities and linkages between different types of energy, the maps visually depicted the apparent issue of human energy in the tropics being 'very low', while levels in Europe and North America were 'very high'. The question for settler colonialism thus became whether the energetic humans of the latter could overcome the climate and seize the unrealised economic potential of the former. The matter was hotly debated, because 'if the climate was really unsuitable [for white human habitation], then the establishment of white settlements was problematic; if the country was to be exploited some other means of organization and administration had to be devised' [6] (p. 307).

The primary alternative to large scale settlement was colonial territory without any pretenses of generating the sort of substantial settlement needed to create a new nation [8]. If *sans* settlement, a new territory was open to being cast as merely an imperial periphery, a landscape harnessed to support the progression of a distant metropolitan core. As the recent revival of the idea of planetary urbanization suggests, many such "sacrificial" landscapes were indeed created, both as colonial territories or – as one could argue about the Northern Territory discussed below – within larger nations. Moreover, the atmosphere itself has been treated in a similarly utilitarian way as a waste site, creating the problem of anthropogenic climate change that is now further calling into question the habitability of some areas, even those with successful settlements to date. In this way, energy can be nation-*unbuilding* as well as nation-building.

2.2. Infrastructural frontiers

We come then to the question of infrastructure. A rich social science literature emphasizes the key role of infrastructure – notably energy infrastructure – in nation- and empire-building, whether in terms of making and claiming territory (e.g. [9]), cultivating a certain sense of national identity (e.g. [10]) or servicing population settlements (e.g. [11]). All demonstrate the role of infrastructure in producing spatial differentiations at multiple scales (cf [1]). And while all are relevant to the case of Darwin/NT/Australia/British Empire below, it is the third option – servicing population settlements – that we want to especially highlight here. This is about the *functional* role of energy infrastructure in mediating the environmental conditions humans experience; that is, as an intermediary between environmental and physiological energies. As opposed to other things that help claim territory (e.g. maps, fences) or construct a national identity (e.g. monuments, anthems), the functional role of infrastructure in mediating the embodied environmental experiences of individuals is what makes infrastructure unique and particularly consequential. More than the sovereign power enacted by territorial claims, or disciplinary power invoked by an ideal national identity, functionally infrastructure enacts biopolitical power by enabling some circulations and cancelling out or redirecting others [12], shaping the milieu in the manner Moheau called for. In this way, it 'exerts a force – not simply in the materials and energies it avails, but also the way it attracts people, draws them in, coalesces and expends their capacities' [13] (p. 243). Specifically, electricity infrastructure exerts a force by offering a much-wanted service to populations, drawing them to it and holding them in place.

Infrastructure's capacity to intentionally shape certain environmental conditions is core to its capacity to create spatial differentials. While a focus on the territorial and national identity roles of infrastructure tends to view an infrastructure system as a whole – as a homogenous, sectoral-specific, aesthetic expanse [14] – a more functional view attends to how energy infrastructure can dynamically produce finer grain spatial variations through networked connections between different types of infrastructure and related developments (see [15]). Those developments include the built environment that is by definition about the generation of environmental difference. When bundled with electricity infrastructure, buildings' capacity to create spatial differentials is heightened. In the nineteenth century the indoors emerged as a microclimatic frontier within the tropical frontier, a new territory facilitated by its alignment with private property. Yet, 'political ecologies of energy often do not discuss the *built environment itself*' [16] (p. 486). More research is needed on 'the Great Indoors' not only because in many places such environments such are backgrounded as "the new normal" for many people, but because numerous 'political projects [are] aimed at the indoors' [17] (p. 173). Many of these perpetuate a 'fallacy of enclosure, the notion that indoor spaces may be physically and socially isolated from the world at large', or in other words, insulated [17] (p. 175).

Emblematic of the concept of insulation or prophylactic security that aims to secure life by "wrapping it up" are *thermal* enclosures. Besides the insulation provided by building materials, thermal enclosures are increasingly created by artificial cooling. The critical literature on air-conditioning, including its relationship to the problematisation of the tropics, is growing rapidly. Mediating tropical conditions by enclosing select indoor spaces and deliberately manipulating the air's condition through building design and technology to convert their tropical atmospheres into a "normal" and "optimal" temperate zone became a major focus in the colonies [4]. In the turn to technological climate solutions a further form of energy – electricity – came into play. Electrified air-conditioning and refrigeration rapidly emerged in the twentieth century as new industries developed around the technologies in the United States [18], harnessing the market opportunity presented by natural non-controlled climates and the rise of large-scale electricity generation that was enabled in many contexts by the expanding use of fossil fuels. Mechanical air-conditioning has since become an increasingly favoured means of mediating the energy balance between human bodies and environment. Driving this turn to air-conditioning is the problematisation of certain (notably warm) climatic conditions by the widespread diffusion of normative notions and experiences of "thermal comfort" [19] and the valorization of the capacity to exert climatic control over one's environment as a sign of a civilized nation [4]. Combined with related developments in Western architecture, professional and cultural practices, and networked urban infrastructural development, air-conditioning has become increasingly obligatory and "essential" [20,21], expanding from the scale of the "capsule" (e.g. the building) to that of the "dome" (e.g. mall) [22]. Through this unfolding frontier of the temperature-controlled interior, settler societies seized upon air-conditioning as a form of 'thermal modernity' [23] and a partial solution to the problem of securing populations in tropical settlement. Air-conditioning can be thought here as an above-ground complement to processes such as geological exploration that try to claim the subterranean. In other words, it is part of a broader effort to 'secure the volume' [24] of the nation state, not only as area, but more fundamentally as an attempt to secure the air itself, in the sense of the medium in which the bodies of the nation state, performing its territorialising settlement as a practice, are rendered comfortable and thus productive and effective agents of territorial and material extension.

Basic to securing the indoor frontier is the provision of electricity, adding to the ways in which electricity fuels processes of national modernization (e.g. Kuchler and Bridge, this issue). By helping insulate "standard" humans against "exceptional" heat, electricity helps progress the economic and civilizational project of the nation by mediating the circulation of energy within the human body to reduce the risk that an excess of heat interferes with individuals' manual and mental capacities. Via air-conditioning's ability to "attract people, draw them in, coalesce and expend their capacities" (to quote Simone above), electricity has helped draw people into not just indoor spaces, but into the broader colonial territories of the tropics. In the process it has helped open up new spaces for energy extraction, production and transportation. The biopoliitics of the resultant spatial divisions can be stark. Urbanist Stephen Graham writes about the 'apartheid atmospheres' by those in and out: 'the increasingly hot, urban world can be starkly divided between those who are inside air-con environments and those who are outside' [19] (p. 207). He notes that exacerbating this are 'the vicious circles that characterise air-conditioned urbanism'. This includes the positive (amplifying) feedbacks generating more environmental heat, including of course anthropogenic climate change that is expanding the tropical zone [25]. As a result, colonial era concerns about the habitability of different spaces are being revived and the frontier of thermally controlled, air-conditioned space is being advanced.

2.3. Hot bodies

The final topic to mention is one that extends Hubers' call to study the linkages between different forms of energy by looking beyond the skin of the human body – as advocated by [26] – to consider its metabolic and excess energies. While infrastructure's functional role can infer the presence of bodies, the latter remains a neglected topic in energy social science. Bodies are implicitly categorized in research as indoor energy-consumer bodies or outdoor energy-provider bodies. But our case of electricity maintenance workers in Darwin blurs this spatial differentiation. Previous work on this group has identified their crucial role in maintaining the grid and the significant physiological strain – not just discomfort – they are under when in extreme heat (e.g. [27]). In this paper, we position such studies within the broader historical agenda of nation-building. While the sacrifice of certain bodies in the name of nation-building is well documented, many such studies focus on the uneven distribution of pollutants and resources. Heat is different

in that it is inherent and necessary to human bodies. It therefore cannot be simply "shut out", but must be instead negotiated and balanced. And key to that balance is the absolute thermal limit our biology places on what conditions human beings can survive, no matter where they are from [28]. With temperatures rising in many environments, human heat exhaustion and stress is an increasingly serious concern for governments around the world, especially in the tropics where humidity greatly exacerbates temperature's effects [29].

Electricity is increasingly central to many people's means of avoiding or expelling heat. Thus the reliability of electricity infrastructure is increasingly important. But electricity infrastructure itself is especially stressed by extreme temperatures [30]. As with bodies, heat is internal as well as external to infrastructure. Electricity infrastructure poses the challenge of balancing not just flows of electricity but those of heat in and out of the equipment. Often exposed to the outdoors, already-hot electricity systems have to contend with environmental heat that threatens to diminish their capacity to generate inanimate, concentrated energy while the same conditions tend to increase demand pressure on generation and transmission capacity. Jumps in demand and/or falls in power generation can cause the system voltage to fluctuate, tripping generators and triggering widespread blackouts. Concurrently, power lines may sag and trip the system or suffer falls in carrying capacity. Longer term, wear to transformers and other transmission equipment accelerates [31]. In multiple ways, environmental heat can increase the likelihood electricity infrastructure will malfunction, threatening its capacity to keep cities and human bodies functioning under the same conditions.

The vulnerability of 'vital systems' to proliferating, boundary-crossing, internal as well as external threats has helped stimulate the rise of another security logic: resilience [32]. In contrast to 'prophylactic' security measures that aim to secure life by "wrapping it up" or efforts to secure passive populations by controlling circulations, the logic of resilience accepts the inevitability of disruptions and valorizes active adaptability and perseverance. In doing so, it reframes repair and recovery as normal and continuous (not exceptional) tasks. In this way it resonates with work in infrastructure studies on maintenance and repair, including explorations of the hidden labour required by formal and informal workers to coax electricity out of broken, unfinished or officially inaccessible infrastructure (e.g. [33]). Although it remains largely unexamined in the literature, the presence of these bodies "in" electricity infrastructure represents a particularly telling intersection of energies: first because it highlights the way electricity is dependent on human bodies and not just the reverse; and second because this relationship is in turn mediated by how the infrastructure and bodies involved are affected in different but related ways by the energies of the wider environment (in this case heat). Combined with the bodies that are kept cool in distant places by the successful negotiation of these intersecting energies, the resultant energy system-environment-human relations mean that the national role of energy systems needs to be understood as entwined with other spaces, scales and processes from the global climate to the metabolics of the human body.

To help illustrate this we turn now to the case of Northern Territory where the question of electricity infrastructure is inseparable from that of climate, especially heat. We consider how the region's climate has constrained, motivated and unsettled a settler society's project of nation-building in which the construction and maintenance of electricity infrastructure has a central role. We then discuss how the Northern Territory's place in the nation reveals further fault lines and tensions in the role of energy infrastructure in Australia's nation-building efforts.

3. Retarding development: climate as a drag on nation building

Australia-the-nation has always struggled to live up to Australia-the-continent. At the heart of this struggle to create a unified nation is the matter of settlement and its biopolitical kernel, population. Since its inception, the "Australian population" (which for a long time officially excluded Indigenous inhabitants) has been considered by some too small to justify its 'tenure of an enormous territory' [34] (p. 48). During the first half of the twentieth century, worries that other nations perceived Australia as a "dog in the manger" (unfairly preventing others accessing its resources) were a persistent topic of political debate [3]. Consequent efforts to populate the territory mean the total population is relatively dispersed, although not sufficiently dispersed according to policy-makers past and present concerned about its vast tracts of "empty" land dotted lightly with outposts such as Darwin.[3] The nation first emerged on paper in 1901 with the Federal Constitution that transformed the collection of colonies into a single, self-governing 'national' entity. Bonding together politically was thought to project a stronger exterior and nation-like integrity, helping keep out the 'crowded 'Near North" (Asia) [34] (p. 48).

Yet in practice, the Northern Territory has been relatively excluded from this project of nation-building-by-settlement. It has been cast as a 'back paddock' for commercial exploitation rather than long-term residence, particularly following strategic decisions by past federal governments to represent it as uninhabitable to put off would-be invaders [3]. Especially marginalized has been 'the North': the tropical, monsoonal zone above the Tropic of Capricorn that stretches across Western Australia, NT and Queensland. The region comprises 40–50% of Australia's land mass, making Australia 'arguably the most "tropical"' of all OECD countries [36] (p. 8). While it is now recognized as rich in natural resources, the tropical environment has been a persistent challenge for settlement of the area. As elsewhere in the world's tropics, whether white settlers can live permanently and productively in such conditions has been fiercely debated. Along with others, geographer Griffith Taylor infamously suggested that the North would never support a substantial white population, not – as some of his peers argued – because the latter could not actually physically survive the heat and humidity, but because – in an anticipation of today's "thermal comfort" norm – they would not be *comfortable* enough to want to stay [37]. Although this sort of 'racist anti-colonialism' [6] (p. 307) was – like today – sharply criticized as pessimistic and unpatriotic, his predictions gained support among those wanting to down-grade Australia's appeal to potential invaders [3]. The predictions have been also largely borne out: it *has* proven difficult to establish a substantial, permanent settler population in the North.

Yet calls to "develop the North" have resurfaced periodically, particularly as fear of Asian invasion has abated and knowledge of the region's geological resources has grown. A recent exemplar is the 2015 report from the federal government, commissioned by the ruling Liberal party – *Our North, Our Future: White Paper on Developing Northern Australia* – that argues that the North could and should jump in population from 1 to 4–5 million by 2060 [38]. More than a place of settlement, though, the report promotes the region as a place for economic production centered on resource extraction, presenting what others have cast as the Big Development narrative about the North's future [39]. Announcing a $5 Billion Northern Australia Infrastructure Facility to support "nation building' infrastructure investments in the north', the White Paper declares with neo-colonialist confidence that 'Northern Australia can grasp its full potential and become an economic powerhouse within our great country' (p. 86). While it acknowledges that the North currently faces some challenges – 'limited population, small industry size, distance, remoteness and climatic conditions' – it promises that the agenda will help 'build a strong, prosperous economy and a safe, secure Australia' as 'the population will grow, the amenity of the region will improve and workers across Australia will be more easily

[3] Contemporary examples of this concern include the establishment of the quasi-government body, the Regional Australia Institute, and related policy initiatives designed to entice people to move to 'regional Australia' – the name given to the large, relatively sparsely-populated proportion of the country outside the large capital cities (see [35]. Rickards, L., *Regional futures: Introduction to special issue.* Australasian Journal of Regional Studies, 2017. **23**(3): p. 295–304.)

recruited and retained' (p. 85, iv, 102).

As has been the case when strikingly similar visions for the North have been proffered in the past, critics have dismissed such suggestions as wildly unrealistic. The difference now is the additional concern about climate change. Pointing to the 'dire future' painted by climate projections for the region, geographer Steve Turton [25] for example, underlines that while 'The White Paper presents a bright future for the north (roads, rail, dams, mining, food production, and tourism)', it 'pays little attention to climatic and other environmental challenges for the region' (p. 9, 8).

Even without climate change, recruitment and retention of people to the region has long faced the problem that for many members of the Australian population the tropics, especially the Wet season, can be uncomfortable. Increasingly, this is a physiological reality. But it is also psychological, with many visitors from elsewhere in Australia experiencing the North – with its marked Wet and Dry seasons – as 'climatically alien' relative to 'the acceptable southern climate" ([40], p. 54). Early colonial advisors noted that surviving the tropics is 'not just a question of illness and death" but of the ability of settlers, especially newcomers, to demonstrate mental as well as physical fitness [6] (p. 316). A major concern now, as then, is that people would give up and leave or "go Troppo": an informal condition characterized by "a multisensory experience of discomposure" [41] (p. 455). To prevent this degeneration, colonial experts recommended 'fastidious attention' to a range of Western behaviours that 'stressed control', including European etiquette, personal hygiene, and avoiding the heat [42]. As we discuss below, avoiding the heat remains a strong public health message today.

Within the North, the NT (about 1.35 million km^2) has proven especially difficult to settle. As a government guide on the NT summarises: 'The harshness of the Territory's climate and its remoteness from the remainder of Australia for many years retarded its development'.[4] With physical difficulties hampering the exploration and surveying of the area, the NT was never formally a colony. Before the Port of Darwin was established, four settlements were tried and abandoned, the last one because 'isolation, disease, cyclones and difficult climatic conditions… made it hard to attract a stable labour force' ([36], p. 3). The NT's so-called 'wastelands' became the 'Northern Territory' under the control of the colony of South Australia in 1863. But the latter was 'ill-equipped to undertake the development' of the vast NT region with its 'special needs', and the colony's 'administration of the Northern Territory failed' [43]. The NT was transferred to the federal government complete with debt and lack of infrastructure in 1911. In addition to the small Australian Capital Territory around the national capital city, Canberra, 3130 km from Darwin, the NT remains the only substantial Territory rather than fully-fledged state. Based in Canberra, the Australian government has consistently managed the Territory instrumentally, with a strong eye for what is best for the nation. As an ex-Minister of NT put it, the task of governors of the Territory is to 'consider policies that were designed to achieve the most favourable outcome accruing to the society of Australia as a whole, rather than to the society residing in the northern portion of the continent alone' (Patterson, 1960, in [43]).

It was not until the early days of WWII that the NT's 'highly dispersed' capital city of Darwin became a 'white majority population' [41] (p. 455). Stimulated by the threat of invasion, the security gaze reoriented from Darwin's unruly population and internal problems to the threat of Asia. As thousands of Allied troops arrived, Darwin materialized as not just a 'colonial outpost' [41] (p. 455) but a garrison town [44]. The securitization of Darwin proved prescient but ineffective when Darwin was heavily and repeatedly bombed by the Japanese in WWII, reinforcing long held geopolitical concerns about the security of the North, and animating them ever since. Beginning in February 1942, the attacks killed approximately 1000 people, injured many more and destroyed infrastructure, including oil stores. The air attack was kept secret from the Australian public so as not to lower their morale or disrupt southern populations. But panic set in among surviving Darwin residents. The 'steamy' weather meant they were 'already sweating' before the bombing started, and conditions were rapidly made unlivable by the damage. A mass evacuation through extremely hostile terrain towards Adelaide (3000 km away) ensued, with 'many soldiers abandon(ing) their training' to join civilians 'in the stampede out of the city'.[5] Many evacuees did not make it, or return.

In rebuilding the city, authorities shaped the city as a military more than civilian space, centered on an air base and international airport. They also seized the opportunity to modernize it and improve upon what had long been criticized as substandard accommodation. This included the expansion of the electricity grid. Electricity had not been introduced to the settlement until 1923, making Darwin the last state or territory capital city in the nation to be electrified. Once installed, it was primarily used to refrigerate and freeze food, and service the military [45]. Until at least the 1950s most dwellings in Darwin had little or no access to electricity [43]. In the 1960s a new power station opened but it was 'fraught with breakdowns' and 'Darwin was plunged into darkness at least once or twice a week'.[6] Infrastructure was finally upgraded through the 1970s as the growing number of military and administrative personnel lifted demand 'for air-conditioning in private, government and business premises'.[7] Awareness was growing that the indoor frontier could help mediate the external one.

Despite its ongoing modernization and population reaching 141,000, Darwin today is still frequently cast within Australia's national discourse as 'a small, remote redneck outpost', featuring in the news media as a site of crocodile attacks, violence, border security and resource extraction [44] (p. 121). Its settlement is still considered somewhat precarious, in keeping with the way 'the dominant Australian discourse' of the nation as 'a fixed population and continuous land use' is 'subverted by white, colonial transience in the Northern Territory" [40] (p. 47). The transience of much of Darwin"s population reflects the fact that many people go there for a specific work opportunity, such as a government posting or the major infrastructure projects discussed below. It also reflects the way climate continues to be a challenge. A recent national survey found that the strongest predictor of Australians' intention to leave their current area because of a dislike of hot conditions is 'living in northern Australia' [46]. Indicative of the ongoing biopolitical governance challenges for the Australian nation, the survey's authors conclude that 'living conditions' in Australia 'may need to be managed if heat-related movement is to be contained' [46] (p. 304).

4. Up-ending development? Climate (change) as a 'threat multiplier' in the North

Climatic factors have not just slowed the development of Darwin, they have periodically stopped it in its tracks. As well as being attacked in WWII, Darwin has been catastrophically damaged by four cyclones, reinforcing not only geopolitical security concerns about the place, but environmental security ones. The worst – Cyclone Tracy – hit on Christmas Day 1974. It killed approximately 77 people, injured many more and triggered the airlift of 30,000 evacuees to other capital cities. Approximately 80% of buildings in the city were destroyed and the city's electricity supply was 'annihilated', with 90% of power distribution lines demolished and water supplies cut off as a result [47]. Although key 'overhead distribution lines were hastily repaired using salvage materials' to restore reticulated power to the hospital, the broader reconnection of electricity took six months and the help of

[4] http://guides.naa.gov.au/records-about-northern-territory/part1/chapter1/index.aspx.

[5] http://www.australia.com/en-my/places/nt/darwin-historical-attractions.html.

[6] https://www.powerwater.com.au/community_and_education/heritage/heritage_power_stations_in_darwin.

[7] https://www.powerwater.com.au/community_and_education/heritage/heritage_power_stations_in_darwin.

'teams of men' from 31 electricity companies and city councils from around the country.[8]

After Cyclone Tracy, administrators grasped the opportunity to once again modernize the city, with one declaring that 'the way is open for the planning of a modern typical town' (in [43]). Concurrently, the cyclone's reminder of the location's environmental insecurity meant new building standards were introduced to increase their ability to withstand severe cyclones. While this did not entirely necessitate a change in architectural style, combined with the desire to "modernize" the city, it resulted in the city's prior vernacular architecture – a tropically-sensitive style designed for air circulation – being largely replaced with lower, heavier buildings more typical of the southern, non-tropical states [47]. Along with these new 'fortress' style buildings came a new dependence on air-conditioning as the new building design not only shut out unwanted external air flows (namely cyclonic winds), but reduced the desirable internal airflows needed for life indoors to be 'tolerable' [47] (p. 50).[9]

Since then, conditions outdoors have become less tolerable and are projected to become even less so with climate change. Rainfall, cyclone intensity and fire risk are projected to increase under climate change [48], as might humidity [44]. Added to this is the basic increase in temperature. July 2017 was the hottest on record[10] and recent projections suggest that already high average minimum and maximum temperatures will increase, with the number of very hot days ($> 35\,^{\circ}C$) in Darwin rising from on average 47 hot days per year to 317 per year (i.e. 87% of days) by 2090, at least if emissions mitigation continues to stall [49]. Worsening the situation is that Darwin's high proportion of concrete and asphalt creates an especially strong urban heat island effect. A recent study found surface temperatures in some of its CBD area of 67° Celsius [50]. No climate analogue exists for Darwin in the future. It is instead 'slowly entering into an unknown world' [25] (p. 5).

Various government agencies dispense public health warnings about extreme heat, recommending people 'avoid exposure to heat – stay in air conditioned buildings'.[11] Newcomers to the North are a special concern, reflecting a sense that some degree of local acclimatization is possible. It also reflects a renewed concern about heat reducing labour and economic productivity [51]. Accompanying the ongoing push to attract migrants to the NT is an effort to educate them about its climatic challenges. International applicants for a skilled migrant visa (directed at attracting electricians and air-conditioning and refrigeration mechanics among others to the NT[12]) are required to demonstrate that they 'have done detailed research into living and working in the NT to show that [they] have a realistic knowledge of the NT including climate, relocation costs and living expenses'.[13] A federal government booklet alerts those thinking about working in the NT about the climate: 'It has to be done. We have to talk about the climate and physical conditions before anything else… don't underestimate its power' [52] (p. 4,5). The booklet explains: 'The climate is harsh… Think heat. Think remoteness. Think air-conditioning' (p. 10).

Many NT residents – like many Australians – are now well trained in thinking air-conditioning. Such is the reliance on it that when an air-conditioning pipe broke at Darwin High School in May 2017, the school was closed until it was fixed.[14] While a substantial number of residents likely struggle to access or pay for domestic air-conditioning given income inequities and the generally high cost of living in Darwin[15], for privileged bodies Darwin functions as a web of artificially cooled 'ecological enclaves' [15]. Mimicking the geopolitical securitization of the nation's territorial borders against refugees, which Darwin is a linchpin in, this securitization of the border between indoors and outdoors requires the constant production of a temperature differential between the two spaces by air conditioners that cool one area while expelling waste heat and atmospheric emissions to the other, perpetuating the 'vicious circles of the air-con city' ([19] p. 207). Reducing greenhouse gas emissions at least, many Australians are putting in rooftop solar, but Darwin is purportedly Australia's "laggard" in this transition, sticking with gas-fuelled centralised electricity to date (though the NT government has recently pledged a rapid transition to 50% renewables by 2050). The transience of the population emerges as a driver as well as cause in the climate change feedback here, with the high proportion of renters (50.3% of the NT population in 2016)[16] slowing the transition to renewables due to being unwilling and/or unable to invest in rooftop photovolatics [53].[17]

The NT's environmental and geopolitical security strategies are not only similar in their reliance on prophylactic approaches designed to keep threats at a distance; the two strategies increasingly intersect. Despite its recalcitrance on emissions mitigation, the Australian government (or military) is becoming progressively concerned about the national security implications of climate change [54]. This growing awareness reflects international moves to 'securitize' climate change and especially US military discourse about climate change as a 'threat multiplier'[18] [55]. Concerns about energy and other resources, related conflicts and environment refugees have contributed to the US's 'pivot' back to Asia and – as a result – Northern Australia [55]. While the NT has been consistently of interest to US-based corporations such as ConocoPhilips – who operate large liquid national gas (LNG) extraction facilities off Darwin under the company's by-line "powering civilization"[19] – Northern Australia's geostrategic importance to the US (and Australia) is once again at the forefront. Encouraged by the US, the Australian Defence Force has built up its presence in the region, as well as built new facilities for the thousands of US marines now rotating through the region to use its "empty" land and air space for heat training and live-fire simulations.[20] As Exercise Kowari (mentioned in the introduction) indicates, also training at times in the NT are troops from China, Australia's primary economic partner. It too has many financial interests in the NT, including mining and pastoral enterprises that produce beef for its domestic consumption. Moreover, a Chinese entity controls (on a 99-year lease), the Port of Darwin. The contract, signed by the Northern Territory Government, caused great consternation in the US,[21] just as the Australian Government partnership with the US military caused serious consternation in China [56]. Meanwhile, Japan – which has built the world's largest LNG processing plant in the Darwin port, discussed below – is another nation moving towards using the NT for military training.[22]

[8] https://www.powerwater.com.au/community_and_education/heritage/electricity_supply_after_cyclone_tracy.

[9] See also http://www.abc.net.au/news/2017-10-31/curious-darwin-top-end-housing/9098446.

[10] http://www.abc.net.au/news/2017-08-01/bom-says-global-warming-behind-record-northern-territory-heat/8762266.

[11] https://nt.gov.au/wellbeing/health-conditions-treatments/heat-stress.

[12] http://www.australiasnorthernterritory.com.au/migrate/migrate-to-work/northern-territory-government-visa-nomination/nt-migration-occupation-list/northern-territory-migration-occupation-list-a-f.

[13] http://www.australiasnorthernterritory.com.au/migrate/migrate-to-work/northern-territory-government-visa-nomination/skilled-nominated-visas.

[14] http://www.ntnews.com.au/news/northern-territory/darwin-high-school-closed-after-damage-to-air-conditioning-pipes/news-story/37232ba95347555735ecf4570563f87b.

[15] http://abs.gov.au/ausstats/abs@.nsf/Latestproducts/6530.0Main%20Features82015-16?opendocument&tabname=Summary&prodno=6530.0&issue=2015-16&num=&view=.

[16] http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/7?opendocument.

[17] http://www.abc.net.au/news/2017-08-22/why-hasnt-darwin-embraced-solar-power-to-help-reduce-power-bills/8824690.

[18] https://www.defense.gov/News/Article/Article/603440/.

[19] http://www.conocophillips.com/about-us/how-energy-works/.

[20] https://www.sbs.com.au/news/next-deployment-of-us-marines-to-australia-to-be-biggest-yet.

[21] https://www.nytimes.com/2016/03/21/world/australia/china-darwin-port-landbridge.html.

[22] http://www.abc.net.au/news/2018-01-13/turnbull-and-abe-to-discuss-military-deal-to-tackle-china/9326760.

5. Driving development: growth, independence and resilience in the NT?

That major nation states with a recent history of hostility are jostling for position on NT soil and using it as a "climate change frontier" to train (perhaps demonstrate) their military capacity while keeping a close eye on their energy and other assets, could be seen as a problematic scenario for the NT and Australia as a whole. Instead, the NT and Australian governments see Darwin's newfound popularity as a chance to progress economic and national security [44]. As the NT government website proclaims:

> The Northern Territory (NT) Government is preparing for the largest period of growth in the Territory's history…. a nation-building exercise to benefit all of Australia… With its natural resources, large undeveloped land mass and its pro-development attitude, Northern Australia is positioned to increasingly contribute to Australia's prosperity… The strong defence presence in the North also plays an important role in the security and development of the nation and its ongoing strategic importance cannot be emphasised enough (NT Dept of Trade, Business and Innovation 2017[23]).

Underpinning this optimism about Darwin's growth is the presumption that it is habitable. But the NT's electricity-enabled habitability is increasingly precarious. The Territory's electricity grid consists of a series of small, regulated networks in Darwin, Tenant Creek and Alice Springs, plus numerous tiny unregulated networks. Significantly, the NT grid is isolated from the rest of the country (Fig. 3). While isolation or modularity can bring resilience benefits, in other ways it leaves the NT especially vulnerable to blackouts. Unlike in the National Electricity Market where power can be redirected between the five connected east-coast states to avoid power outages, when power outages threaten in the NT – as they frequently do due to environmental interference, the need to quickly complete grid maintenance during the Dry season,[24] ageing electricity infrastructure [44], or gas turbine inertia [57] – there is no capacity to draw on power from across state borders. Thus, rapidly repairing the electricity network is especially important aspect of operating a resilient grid in the NT. At the same time, rapid repair is unusually difficult in the NT. As the government-owned company Power and Water that owns and runs the electricity transmissions and distribution network puts it, although it aims to 'maintain system reliability', it 'operates in diverse climates, each of which brings with it unique challenges' [58] (p. 27, 18). These 'geographic and environmental variations', the company points out, influence their 'ability to respond to incidents on the transmission and distribution systems' (p. 18).

With its emphasis on adaptability, resilience has long been a value associated with the NT. The Territory is commonly celebrated in national discourse as an icon of Australia's purported naturalness, toughness and ingenuity. Even Darwin's reliance on linesmen risking their bodies and lives to keep its grid functioning fits this nationalistic reading of the NT as a place where things are always risky and contingent – and exciting for it. Linesmen arguably exemplify the traditional masculine figure of the ideal Australian [59], heroically coaxing electricity to flow through searing, recalcitrant transmission lines in volatile or sweltering conditions in defiance of their own bodily limits to keep Darwin functioning, the Territory viable, and the nation intact. By fulfilling this role, they help others to not only live electrically-insulated modern lives, but to believe in the optimistic version of Australia's settlement in which a once-British population is tested and found capable of coping – collectively if not individually – with whatever the once-unfamiliar, famously volatile climate throws at them.

Yet the linesmen's position at the increasingly sharp intersection of climatic, physiological and electrical energy also points to two problems with this romantic rendition of the NT and its role in nation-building. First, while the linesmen venture outside the artificially sustained comfort of Darwin's urban environment to work on the system that underpins it, they are not external to the system, but themselves remain physically reliant upon it. Like the general population that the government warns to remain cool, linesmen have thermal bodily limits that demand respect when environmental conditions add to their thermal load. Combined with the additional thermal load generated by physical labour in the vicinity of hot electricity infrastructure and equipment, their need to quickly cool their bodies at work and after work is especially acute. Such cooling is about more than thermal *comfort;* it is a matter of survival and safety. It is essential that such workers maintain their core body temperature within safe limits to protect themselves, their work mates and the systems they are intervening in [60]. The thermal loads they need to manage are also carried within their bodies long after they have left hot spaces behind, lagging temporally in a way that implicates their practices in all areas of their life. Physiological research suggests that the most effective means of rapid cooling are generally electricity-enabled techniques, namely ingesting ice, being immersed in cool water or resting in air-conditioned spaces. In offices, workshops and at home, these amenities are dependent on electricity [61]. The upshot is that linesmen are as, if not more, dependent on a functional electricity grid than other electricity consumers. This codependency of linesmen and electricity lines blurs the boundary between inside and outside, domestic and professional spaces, infrastructure and human needs, and electricity production and consumption, revealing the complexity of energy geographies in ever more energetic climates. Moreover, it reveals an overlooked insecurity within energy systems – human bodies – a vulnerability that a resilience security approach highlights but does not necessarily successfully reduce, being as it is, in this instance, reliant on the success of ongoing prophylactic security measures.

Second, resilience is a scalar concept and the practical scale politics involved in the NT electricity situation is one that implicitly prioritises the system over the linesman, and the nation over the NT. As others have outlined (see [32,62]), resilience arose as a new security logic in step with emerging awareness within the US and British military over the World War period that 'vital systems' and thus nations are vulnerable to catastrophic disruptions of an unpredictable and unavoidable sort. As Darwinians knows better than the rest of Australia, such disruptions can come in the form of air-borne threats. In military thinking, the two that especially altered thinking on security were the rise of strategic aerial bombing of enemy's production systems, and gas warfare that rendered the atmosphere itself uninhabitable [63]. According to Duffield, in the face of such 'environmental terror', resilience emerged as an 'official response' or strategy [64].

In the NT, these two forms of environmental terror are especially entwined because attacks on energy systems would undermine the capacity to continue generating an artificially inhabitable atmosphere in a temperature and humidity sense. Maintaining the resilience of Darwin and its electricity grid is a well-rehearsed priority. But it is one contingent on "actors" at lower and higher levels. At the lower level, Darwin's electricity grid and thus the settlement of Darwin is – as indicated above – reliant to a significant degree on linesmen. Given how close to the edge of collapse such individuals already operate, helping to protect them from worsening climatic conditions by reducing the contribution of the energy system to climate change would seem a logical response. However, from the persecptive of national-scale discourses of development, such individuals are invisible while in Darwin the retreat indoors means the outside environment and all those in it are increasingly externalized. Instead, as economic and biological dependence upon the grid has grown, its resilience has become a good in

[23] https://business.nt.gov.au/business/investment-and-major-projects/northern-australia-development.

[24] http://www.ntnews.com.au/news/northern-territory/power-and-water-warns-top-end-power-interruptions-will-continue/news-story/88f38a3de79ce09d351feb22cf8d9e0f.

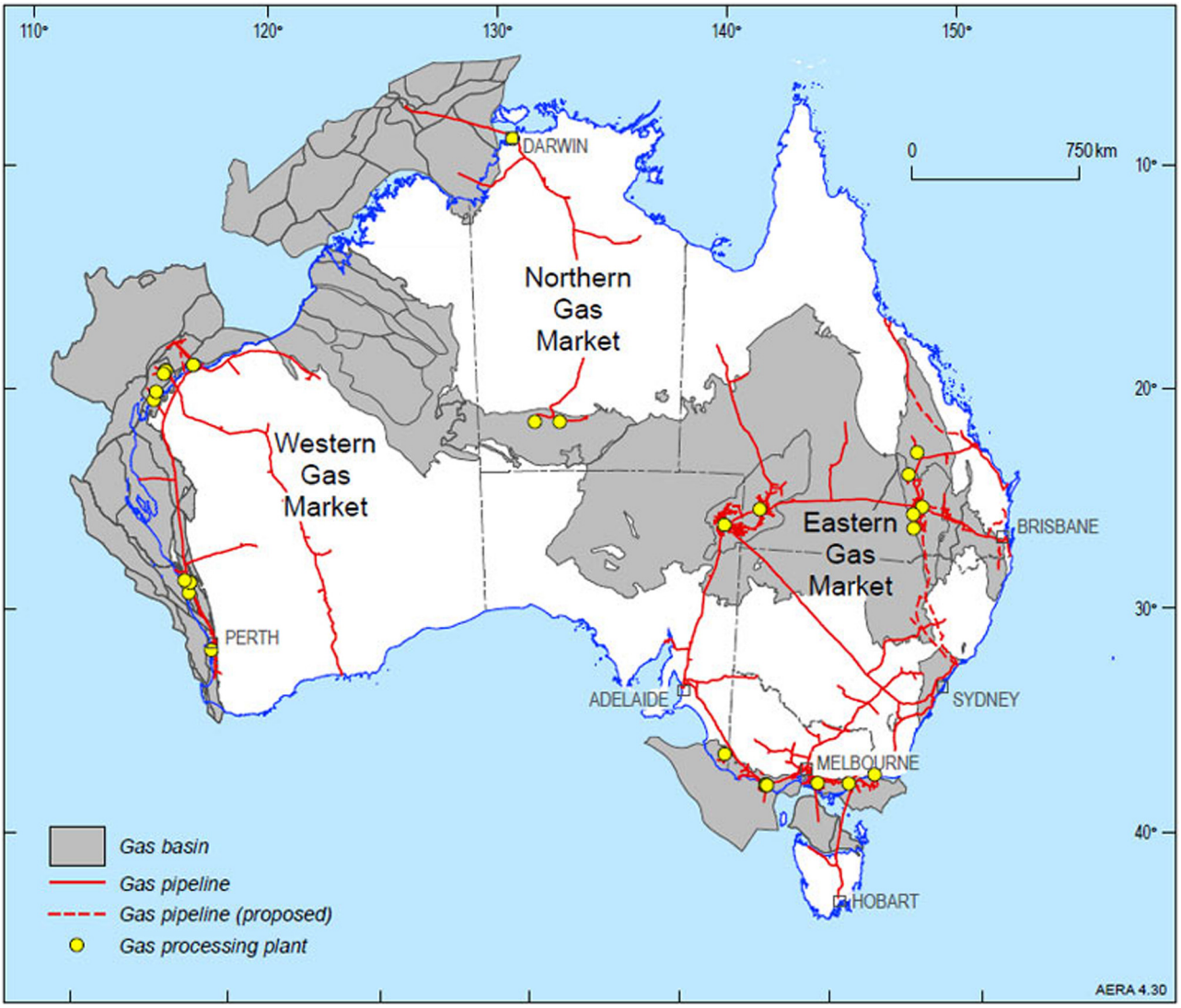


Fig. 3. Australia's gas infrastructure, 2016.
Source: Geoscience Australia, http://www.ga.gov.au/scientific-topics/energy/resources/petroleum-resources/gas.

itself, largely insulated from debate about the uses to which the NT's electricity is being put, to what effect, and at whose expense.

At the same time as being reliant on "lower scale" performances of resilience by individual linesmen, Darwin and the NT are vulnerable to assertions "from above" by sovereign and corporate power. Arguably indicative of this are recent moves to open the Territory to foreign military activity in support of national geopolitical interests. Most recently, the federal government has been trying to use the NT to bolster domestic energy security, pressuring it to sell its gas into the main Australian market – the Eastern Gas Market. The eastern states have been suffering an apparent domestic gas shortage due to most of their own gas supplies being exported. At present, NT gas is sold into its own isolated Northern Market or to offshore buyers (Fig. 4). According to critics, the broader "energy crisis" in Australia[25] that the domestic gas shortage is part of has been partially caused by policy neglect of the geographic barriers the continent poses to nationalizing the electricity market [65]. Yet the federal government is pushing once again to overcome or deny such physical barriers and tie together the Northern and Eastern markets via an enormous new pipeline. It is an ambitious project justified by the expectation that NT would develop more gas reserves to supply it. As the Energy Minister stated: 'We know that the NT is sitting on 200 years worth of gas resources. Gas is critical to Australian businesses, it is critical to Australian families…'.[26] That gas includes undeveloped on-shore unconventional gas fields currently protected by a NT government moratorium on fracking. The moratorium reflects concerns that opening up the coal seam gas fields would release vast quantities of greenhouse gas emissions.[27] Despite widespread protests, the moratorium's future is uncertain, with a 2017 NT government inquiry indicating that the coal seams could be developed while managing the risks[28] [66]. Moreover, the federal government has threatened to restrict the Territory's right to export gas if it does not lift the moratorium.

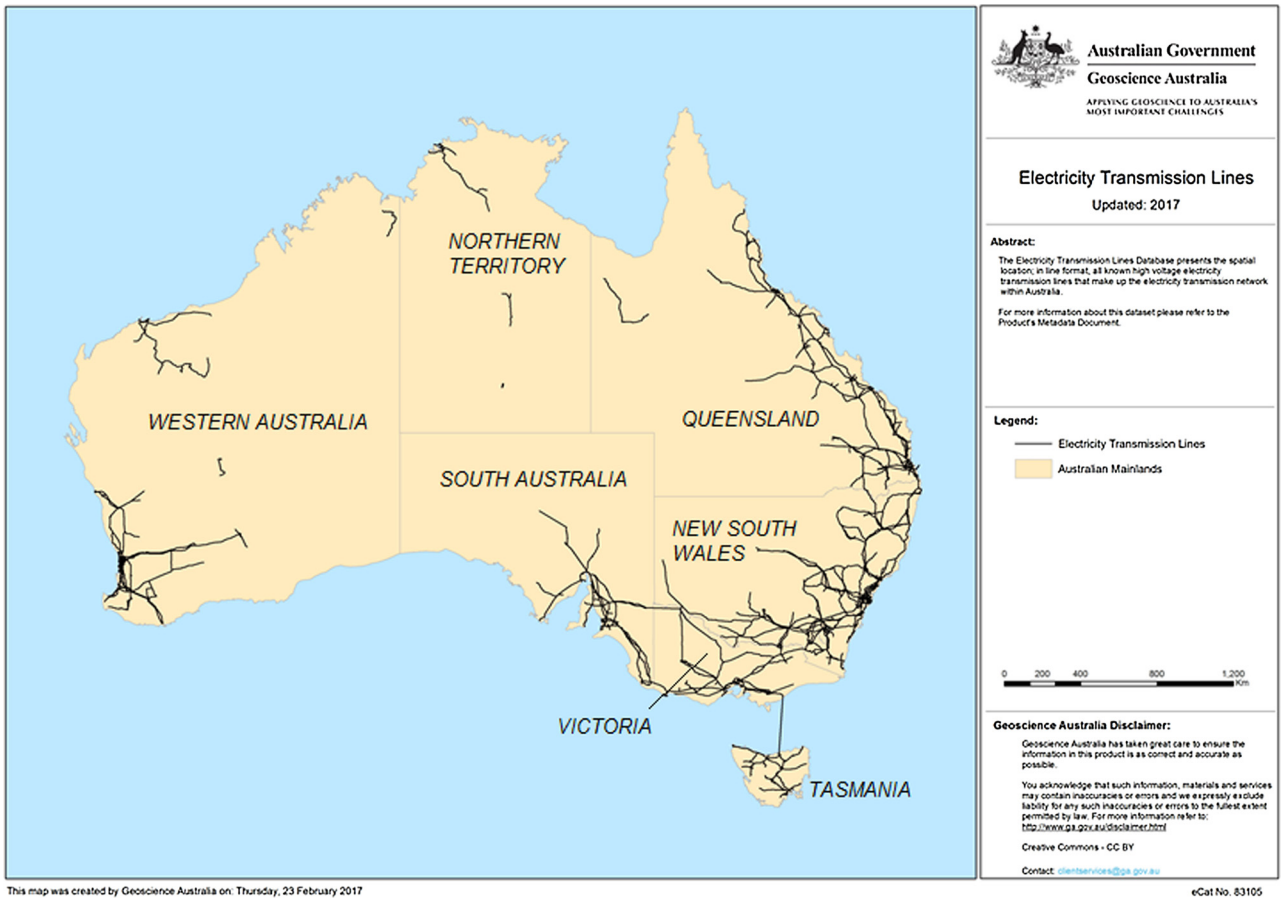
This federal reassertion of domestic energy security goals is consistent with its utilitarian attitude to the NT. It also reflects a degree of resource nationalism. But to date Australia's resource nationalism has been far less strident than this move to curb exports, being instead of a 'soft' or 'market-based' type [67] that reflects its concurrent economic

[25] http://www.abc.net.au/4corners/power-failure/8497716.

[26] http://www.ntnews.com.au/business/nt-key-to-averting-gas-crisis-feds/news-story/ae01e5f994b0184ce4d11f4935334409.

[27] http://www.abc.net.au/news/2018-02-27/fracking-ban-in-nt-should-stay-say-leading-climate-scientists/9486380.

[28] https://frackinginquiry.nt.gov.au.


NORTHERN TERRITORY
WESTERN AUSTRALIA
QUEENSLAND
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
TASMANIA
Australian Government
Geoscience Australia
APPLYING GEOSCIENCE TO AUSTRALIA'S MOST IMPORTANT CHALLENGES
Electricity Transmission Lines
Updated: 2017
Abstract:
The Electricity Transmission Lines Database presents the spatial location, in line format, all known high voltage electricity transmission lines that make up the electricity transmission network within Australia.
For more information about this dataset please refer to the Product's Metadata Document.
Legend:
Electricity Transmission Lines
Australian Mainlands
0 200 400 800 1,200 Km
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This map was created by Geoscience Australia on: Thursday, 23 February 2017
eCat No. 83105

Fig. 4. Australia's electricity transmission lines, 2017.
Source: Geoscience Australia.

strategy of 'internationalisation' (attracting international investors with bundles of incentives including infrastructure [68]). The latter policy is one that the NT has been excelling at. Indeed, adding to the NT government's optimism above about the Territory entering 'the largest period of growth' in its history, is the fact that the NT recently won the contract to host "the single largest construction project in Australia": the $US37 billion construction of a LNG processing plant for Japanese company Inpex in Darwin Harbour. The project is part of Inpex's Ichthys gas field project designed to supply gas to Japan 'for the next four decades' and moves Australia towards becoming the world's largest LNG exporter [69]. To win the deal, the NT differentiated itself from its rival state Western Australia (WA) thanks to its more "pro-business" environmental and cultural heritage regulations, offer of access to existing pipelines, and – notably – willingness to allow Japan to export all of the gas [44]. The latter sat in contrast to WA's insistence on retaining 15% of the gas for its own consumption, a sub-national version of resource nationalism that reflects not only the fact that WA (unlike the federally-funded NT) has to fund the infrastructure used to attract the resource industry [67], but that it has a larger population to provide for, and possibly a more confident sense of its population's future.

Publicity about the NT government's negotiations with Inpex noted that 'Darwin itself was a major attraction' to the company. Inpex stated that the city location would 'attract a workforce' more easily than if the plant was sited 'out in the middle of nowhere'. Such endorsement was a relief to those still anxious that Darwin itself may be a nowhere.[29] In reality, the thousands of temporary Japanese workers for the project have been housed in the 'Lego-land fortress' of Inpex Accommodation Village on the outskirts of the city ('New Darwin'). The remote location means that in practice the workers' 'like or dislike of Darwin itself will be of no real consequence' because they rarely get to the city ([44] p. 219). While basic, the accommodation is air-conditioned, pointing to the company's awareness of the need to help keep construction workers – like the linesmen discussed above – physically functioning in hot conditions. While worker accommodation is generally overlooked in discussions of 'gas infrastructuring' (cf Finley-Brook et al., this issue), as a factor in worker performance it is an important element in how the use value of gas is transformed into exchange value [70]. More specifically, it is a reminder of how labour entwines the energy of gas with that involved in human physiology and atmospheric conditions.

Inpex's decision to house workers in a cheap rather than central location reveals its pragmatic attitude to not just the workers, but to Darwin, the NT and Australia. Inpex's reaction to the federal government's threats to limit the NT's gas exports further suggests the contingent nature of its loyalties, with the CEO darkly warning that such limits would threaten their company's and other long-term investors' 'confidence' in the NT and Australia as a stable supply source and force them to look elsewhere.[30] Such a warning triggers Australia's and especially the NT's long-held fears of abandonment [71]. It is also a threat that is painfully familiar. Indeed, it is arguably in response to warnings about the dispensability of Australia as an investment site that the federal government is scrambling to boost gas supply and lower gas-powered electricity prices in the eastern states, where other large

[29] http://www.ntnews.com.au/business/how-the-nt-beat-the-rest-of-the-world/news-story/8ca69a5b127e5a4b537327531e778d42.

[30] https://thewest.com.au/business/oil-gas/lng-curbs-put-dent-in-confidence-inpex-chief-ng-b88635231z.

electricity-intensive businesses such as American aluminum producer Alcoa are demanding cheap and reliable electricity if they are to not move their operations offshore.[31]

At the same time, the energy infrastructure and systems needed to deliver on these demands are themselves under growing stress as the climate change that they are contributing to worsens. Significantly, climatic warming is a stress on gas liquefaction. While Darwin may not have a large population to supply with electricity, it increasingly needs reliable power to cool the gas that Inpex, ConcoPhillips and others are exporting. It is a process made more energy-intensive by hotter ambient temperatures [72], as well as emissions-intensive by the fact it is currently itself being fuelled by (different) natural gas. Energy infrastructure in the rest of the country is also increasingly under stress from climate change as the tropical climate that has long distinguished and arguably stigmatised Australia's North moves southward [25]. The tropical zone has now overflowed its cartographic boundary of the Tropic of Capricorn and started to remake Australia's physical and thus sociopolitical geography. This spread of tropical heat across the continent is further entrenching the reliance on air-conditioning. Combined with growing consumption of electricity by industry (including gas liquefaction) this demand is putting increased pressure on the centralised electricity grids across the country. With this pressure comes the risk of blackouts. Recent examples have proven economically very costly, reinforcing calls by corporations and others to bolster the resilience of Australian's grid with fossil fuel base load and better network integration [73]. Drawing on the NT's gas supplies is one apparent route to improved resilience for the eastern states and thus the "nation", but it is a route that particularly exposes the political and physical precarity of the NT population, the fault lines internal to "nation"-building, and the paradoxical, biopolitical feedbacks involved.

6. Conclusion

The NT occupies an ambiguous position in the Australian national imaginary. On the one hand, it is part of the continental entity that underpins the nation as institution, and is periodically called upon to play its part in a unified Australia. On the other hand, ever since British settlement – only 230 years ago – there has been concern over how to settle and utilize the Territory in a way that maximizes its contribution to the national economy and justifies Australia's claim to the area to imagined onlookers. Basic to this concern is the area's tropicality. While Darwin is now an established city of approximately 120,000 residents, it and the NT as a whole are externalized in the national imaginary by appellations such as the Outback, by topographical barriers, and by network isolation. Similar processes of segmentation are at work at higher and lower scales. Australia as a whole has been cast as an external periphery in the geographical imaginaries of both British colonialism and the geopolitical and economic dominance of the Global North, whether the latter is seen as centered in the United States or new industrial giants such as China. In this sense, the NT is a periphery within a periphery. Anxious to secure financial flows, it has cooperated with various international interests to develop a particularly extractive approach to development in the region, one in which energy is enabler, hindrance and side-effect. Examining the role of Darwin as settlement and infrastructure hub as well as resource site brings to the fore how understanding energy as multiple in its forms and effects can expose the knotty links between infrastructure, environment, bodies and culture. Despite – or perhaps because of – the ongoing construction of the finer-scale indoor frontier, these knots promise to get bigger as different actors and agendas converge on the region. The positive feedback loop between energy extraction/consumption and climate change exemplifies what is at stake.

Overall, in this paper we use the case of Darwin to shed light on the multifarious role of energy infrastructures in Australia's ongoing nation-building efforts. Matters of infrastructure are inseparable from questions of people and inter-national and intra-national politics, and we have highlighted the multiple powers, energies, frontiers and feedback loops involved in Australia's nation-building effort. In doing so, there are three main conclusions we want to highlight. First, in considering the role of infrastructure in nation-building, it is vital to attend simultaneously to relations between different forms and scales of power (such as the Foucauldian distinction between sovereign power and biopower), and to the sticky relations between different types and sites of energy, notably electrical, environmental and bodily energy. Specifically, climate change demands that we take seriously the role of heat and attend to how it circulates, disperses and accumulates across scales, in intentional and unintentional ways, and between electrical infrastructure, climate and human bodies. Viewed through the lens of heat, energy is revealed as foundational, and as a hindrance, enabler and side-effect of the nation-building project.

Second, a cross-scale perspective is needed to apprehend the multiple frontiers involved in nation-building. Climatically, discussions of nation-building and energy need to be located within not just abstract talk of climate (change) but within specific, culturally differentiated climatic zones of the sort invented, mapped and transcended by colonialism – and now shifting under global warming. Taking this more geographically specific approach exposes how the Tropics were coproduced ideologically and materially within the new nation-building efforts of Australia's settler colonialism project, and how questions of energy are central to both. It also helps illuminate how the space of the nation is, in part, produced through the space of the indoors. National and interior frontiers are coproduced in difficult external environments. In the NT, the cooling of buildings and bodies is inseparable from the making of the nation and the ongoing opening up of its tropical territories for further resource extraction.

Third, it is critical to appreciate the multiple feedback loops involved. The energy-begets-energy feedback loop that Australia has used to construct itself as a nation has triggered various paradoxes and dangers, including the risky positive feedback loop of a race for its resources and the related production of hotter conditions under climate change. As in other areas, there are real questions about the future of permanent settlement at Darwin above and beyond what is minimally required for energy extraction and military bases. Breaking out of this bind is more than a matter of economic policy, foreign policy, architectural standards, thermal norms, new pipes or labour laws. Rather, the challenges are deep rooted and interlocked and require coordinated change in multiple spheres. This multiplicity reflects the multiple, foundational, historical role of energy in society, as Matthew Huber has underlined. In the NT and Australia, these multiple forms, frontiers and feedback loops mean that energy – broadly defined – acts as hindrance as well enabler and side-effect of nation-building projects. Appreciating that nation-building involves infrastructure requires appreciating that infrastructure not only transfers concentrated inanimate energy, but mediates between, and is dependent on, environmental and physiological energies. In highlighting these knotted relations, this paper takes a step towards a more 'thoroughly geographical' [1] account of the relation between energy infrastructures and nation-building, and the troubling paradoxes and tensions that can be involved within and beyond a nation's borders.

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[31] http://www.theaustralian.com.au/news/nation/jobs-at-risk-blackouts-spook-big-companies/news-story/3d13f83bcc32b07f5a996dbf7e0b5ccb.

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